PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions Specification Sections, apply to this Section.

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 7 Section "Roof Accessories" for roof curbs, piping supports, and roof penetration boots.
   2. Division 7 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through basement walls and fire/smoke barriers.
   3. Section 15075 "Mechanical Identification" for labeling and identifying refrigerant piping.
   4. Section 15083 "HVAC Insulation" for pipe insulation.
   5. Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment".
   6. Section 15671 “Condensing Units”.
   7. Section 15672 “Air Cooled Condensers”.
   8. Section 15725 “Modular Indoor Air Handling Units”.
   9. Section 15734 “Computer Room Air Conditioning Systems”.
   10. Section 15763 “Fan Coil Units”.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants.

B. All refrigerant systems shall be designed for an ambient temperature of 125 degrees F., No Exceptions. All capacity reductions shall be included in the equipment selection to meet the capacities indicated on the drawing schedules. Contractor shall use caution in the selection of all components and piping routes to meet the schedule. Provide the manufacturer’s written guarantee that scheduled capacities will be met.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.

B. Product Data for each service and isolation valve type, solenoid, expansion valve, dryers, site-glasses, and refrigerant piping specialty specified or shown on the drawings.

C. Shop Drawings showing layout of refrigerant piping, insulation types and sizes, hangers with vibration control amenities, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.
1. Refrigerant piping indicated on the drawings are schematic only. Size and
design the layout and installation of the piping, including oil traps, double risers,
specialties, and pipe and tube sizes, to ensure proper operation and
conformance with warranties of connected equipment.

D. Shop Drawing submission and refrigeration component selections shall include the
equipment manufacturer's written approval of the layout for the refrigeration piping
system. Capacity reductions shall be provided to the Owner for approval, prior to
commencing installation work.

E. Qualification data for firms and persons specified in the "Quality Control" Article to
demonstrate their capabilities and experience.

F. Maintenance data for refrigerant valves and piping specialties to include in the operation
and maintenance manual specified in Section 15050 "Basic Mechanical Materials and
Methods."

1.4 QUALITY CONTROL

A. ASME Compliance: Qualify brazing and welding processes and operators according to
ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing
Qualifications."

B. Regulatory Requirements: Comply with provisions of the following codes:
1. ASME B31.5, "Refrigeration Piping."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing
Components and Accessories, Non-electrical"; or UL 429, "Electrically Operated Valves."

D. Listing and Labeling: Provide products specified in this Section that are UL listed and
labeled.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.
Roof specialties are specified in Division 7 Sections.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with
protective covering for storage, and are identified with labels describing contents.
1. Refrigeration Oil Test Kits: 2 each, containing everything required to conduct 1
test.
2. Refrigerant: 2 containers each, with 30 lb of refrigerant.
3. Filter-Dryer Cartridges: 3 of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Refrigerants:
      b. DuPont Company; Fluorochemicals Div.
      c. Elf Atochem North America, Inc.
      d. ICI Americas Inc.; Fluorochemicals Bus.
   2. Refrigerant Valves and Specialties:
      a. Eaton Corporation; Industrial Control Div.
      b. Emerson Electric Company; Alco Controls Div.
      c. Henry Valve Company.
      d. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
      e. Sporlan Valve Company.

2.2 REFRIGERANT PIPING

A. Operating Pressure: Up to 550 psig
B. Water cooled: R-134A - 300 psig
C. Air cooled: R-134A - 300 psig
D. Suction Lines for Heat Pump Applications: R-134A - 550 psig
E. Hot Gas and Liquid Lines: R-134A - 550 psig
F. Temperature: 30 to 200 deg. F
G. Construction: Brazed connections, silver solder with non corrosive flux.
H. Tubing: Type "ACR", hard drawn copper conforming to ASTM B280.
I. Fittings: Brazing type, wrought or cast bronze pressure fittings conforming to ASTM B 61, B 62 or B 75.
J. Unions: Not to be used.
K. Flanges: Used only as an integral part of equipment.
L. Branch Connections: Use fittings.
M. Gaskets: Used only as an integral part of equipment.
N. Bolts: Used only as an integral part of equipment.
O. Two Way
SECTION 15183

REFRIGERANT PIPING

Line Valves: 1/4" through 5/8" O.D.  Sweat type  Packless  Superior 204 4S through 206 10.

7/8" through 4 1/8" O.D.  Sweat type  Packed  Globemaster VG 14 through VG 64.2.

P. Globe Valves: 1/2" through 1 1/8" O.D.  Sweat type  Packless  Superior 207 12S through 209 11S.

1 3/8" through 4 1/8" O.D.  Sweat type  Packed  Superior 492 13S through 498 41S.

Q. Check Valves: 1/4" through 7/8" O.D.  Sweat type  Spring operated  Superior 802 4S through 804 14S.

1 1/8" through 4 1/8" O.D.  Sweat type  Superior 80611S through 815 41S.

R. Silver Solder: 45 Percent Silver, 30% Copper, 29.5% Zinc  Safety-Silv 45 or Mueller Brass Company's No. 122.

S. Silver Solder Flux: Stay-Silv Model 40022 White Brazing Flux.

R. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.

S. Pressure-Regulating Valves: Conform to ARI 770; pilot operated, forged brass or cast bronze with pilot operator, stainless-steel bottom spring, pressure-gage tappings, 24-V dc standard coil, and wrought-copper fittings for solder-end connections.

T. Pressure-Regulating Valves: Conform to ARI 770; direct acting, brass with pilot operator, stainless-steel diaphragm, standard coil, and solder-end connections.

U. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.

V. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

W. Hot-Gas Bypass Valve: Adjustable, sized for capacity equal to last step of compressor unloading; solder-end connections and voltage to match the refrigerant system equipment component voltages.

X. Expansion Control: Provide expansion control devices to control thermal expansion in the piping system, and vibration between units and piping distribution.

2.3 REFRIGERANT PIPING SPECIALTIES

A. Straight- or Angle-Type Strainers: 430-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen, and screwed cleanout plug, with solder-end connections.
SECTION 15183
REFRIGERANT PIPING

B. Straight, Non-Cleanable-Type Strainers: 500-psig working pressure; steel shell with stainless-steel screen, with solder-end connections.

C. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.

D. Replaceable-Core Filter-Dryers: 500-psig operating pressure; steel shell, flange ring, and spring, ductile-iron cover plate with steel cap screws, and wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets, as follows:
   1. Filter Cartridge: Pleated media with integral end rings, stainless-steel support, ARI 730 rated for capacity.
   2. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.

E. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

F. Flanged Unions: 400-psig working pressure, 330 deg F maximum operating temperature; 2 brass tailpiece adapters for solder-end connections to copper tubing; forged-steel flanges for 1- to 1-1/2-inch nominal copper-tube size and ductile iron for 2- to 3-inch nominal copper-tube size with 4 plated steel bolts, with silicon bronze nuts and fiber gasket; factory-applied rust-resistant coating on flanges and bolts.

G. Flexible Connectors: 500-psig operating pressure; seamless tin-bronze or stainless-steel core, high-tensile bronze-braid covering, solder-end connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inches long.

H. Mufflers: 500-psig operating pressure, brazed-steel construction with fusible plug, sized for refrigeration capacity.

2.4 RECEIVERS

A. 6-Inch Diameter and Smaller: ARI 495, UL listed, steel, brazed; 400-psig pressure rating, with tappings for inlet, outlet, and pressure relief valve.

B. More than 6-Inch Diameter: ARI 495, welded steel, tested and stamped according to ASME Boiler and Pressure Vessel Code, Section 8D; 400 psig with tappings for liquid inlet and outlet valves, pressure relief valve, and liquid-level indicator.

2.5 REFRIGERANT

A. ASHRAE 34, R-134A: Tetrafluoroethane.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Aboveground, within Building: Type ACR drawn-copper tubing.

B. Aboveground Alternate within Building: Type L drawn-copper tubing (cleaned and dehydrated).

C. Belowground for 2-Inch NPS and Smaller: Type L annealed (cleaned and dehydrated)-copper tubing in insulated conduit.

D. Belowground for Larger than 2-Inch NPS: Type K annealed (cleaned and dehydrated)-copper tubing in insulated conduit.

3.3 INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Section 15050 "Basic Mechanical Materials and Methods."

C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.

D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Belowground, install copper tubing in conduit. Vent conduit outdoors.

G. Insulate suction lines and liquid lines, but insulate them together if adjacent.
   1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.

I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

J. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
   2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.
3. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
4. Liquid lines may be installed level.

K. Use fittings for changes in direction and branch connections.

L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.

N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS.

O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.

P. Install flexible connectors at the inlet and discharge connection, at right angles to axial movement of compressor, parallel to crankshaft.

Q. Install replaceable-core filter-dryers, with isolation valves and valved bypass.

R. Install refrigerant valves according to manufacturer’s written instructions.

S. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.

T. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

U. Mount thermostatic expansion valves in any position, close to evaporator.
   1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
   2. Install valve so diaphragm case is warmer than bulb.
   3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
   4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

V. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.

W. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.

X. Charge system as follows:
   1. Install filter-dryer core after leak test, but before evacuation.
   2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg F is indicated on vacuum dehydration indicator.
   3. Maintain vacuum for a minimum of 5 hours.
   4. Break vacuum with refrigerant gas and charge to 2 psig.

3.4 HANGERS AND SUPPORTS
A. General: Hangers, supports, and anchors are specified in Section 15060 "Hangers and Supports." Provide according to ASME B31.5 and MSS SP-69.

B. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

C. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

D. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.

E. Spring hangers to support vertical runs.

F. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.
   1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

G. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. 1/2-Inch NPS: Maximum span, 84 inches; minimum rod size, 1/4 inch.
   2. 3/4-Inch NPS: Maximum span, 84 inches; minimum rod size, 1/4 inch.
   3. 1-Inch NPS: Maximum span, 84 inches; minimum rod size, 1/4 inch.
   4. 1-1/4-Inch NPS: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. 1-1/2-Inch NPS: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   6. 2-Inch NPS: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   7. 2-1/2-Inch NPS: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   8. 3-Inch NPS: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   9. 4-Inch NPS: Maximum span, 14 feet; minimum rod size, 1/2 inch.

H. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Basic pipe and tube joint construction is specified in Section 15050 "Basic Mechanical Materials and Methods."

B. Provide a continuous purge of inert gas (nitrogen) during brazing to prevent formation of scale.

C. All testing of piping and joints shall be performed using inert gas (nitrogen) at the test pressure indicated in Section 15950 "Testing, Adjusting and Balancing", unless otherwise specified.

3.6 VALVE INSTALLATIONS

A. Install refrigerant valves according to manufacturer's written instructions.
B. Install valves on suction and discharge of compressor, for gage taps at compressor inlet and outlet, for gage taps at hot-gas bypass regulators, on inlet and outlet, and on each side of strainers.

C. Install check valves on compressor discharge and on condenser liquid lines on multiple condenser systems.

D. Install refrigerant-charging (packed-angle) valve in liquid line between receiver shutoff valve and expansion valve.

E. Install globe valves or refrigerant ball valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

F. Install a full-sized, 3-valve bypass around each dryer, so operations of the refrigerant system do not have to be shut-down.

G. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
   1. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

H. Mount thermostatic expansion valves in any position, close to evaporator.
   1. Where refrigerant distributors are used, install directly on expansion-valve outlet.
   2. Install valve so diaphragm case is warmer than bulb.
   3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
   4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

I. Install pressure-regulating and relief valves as required by ASHRAE 15.

3.7 SPECIALTIES APPLICATION AND INSTALLATION

A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.

B. Install strainers immediately upstream of each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

C. Install strainers on main liquid line where multiple expansion valves with integral strainers are used.

D. Install strainers in suction line of steel pipe.

E. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

F. Install pressure relief valves on ASME receivers, and pipe to outdoors.

G. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.
H. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

I. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

J. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.

K. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.8 CONNECTIONS
A. Electrical: Conform to applicable requirements of Division 16 Sections for electrical connections.

3.9 FIELD QUALITY CONTROL
A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.
   1. Pressure test with nitrogen at the same pressure as listed in Article 2.2 of this Section. Perform final tests at 27-psig vacuum and 550 psig using halide torch or electronic leak detector. Test to no leakage.

B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

C. Repair leaks using new materials; retest.

3.10 ADJUSTING
A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.11 CLEANING
A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene. No Exceptions. Seal all open ends and leave a holding charge of nitrogen gas until actual installation to prevent oxidation and contamination.

3.12 COMMISSIONING
A. Charge system using the following procedures:
   1. Install core in filter dryer after leak test, but before evacuation.
   2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg F is indicated on vacuum dehydration indicator.
   3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
   4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
   5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge with recorded pressures and temperatures associated with the system.

END OF SECTION